What is claimed is:

1. A polishing method for polishing an object having a film on a surface to be polished, comprising the steps of

measuring data corresponding to a thickness of the film on the object and

making a relatively small cathode member compared with the surface face a region of the surface, interposing an electrolytic solution at least between that region of the surface and the cathode member, and in that state applying a voltage with the cathode member serving as a cathode and the film as an anode to electrolytically polish and flatten the film by electrolytic elution in that region of the surface preferentially from projecting portions of the film until removing a target amount of the film obtained from the thickness equivalent data; wherein

the process of moving the cathode member to another region of the surface and electrolytically polishing the film in that other region until removing the target amount of film to flatten the film is repeated over the entire surface, to thereby remove the target amount of film over the entire surface.

2. A polishing method as set forth in claim 1, wherein the film comprises a copper film.

3. A polishing method as set forth in claim 1, further comprising a step of calculating the amount of the film to be removed from the thickness equivalent data after the step of measuring the thickness equivalent data and before the step of electrolytically polishing and flattening the film by electrolytic elution in that region of the surface.

4. A polishing method as set forth in claim 1, wherein the cathode member is moved continuously from one region to another region of the surface.

5. A polishing method as set forth in claim 4, wherein the speed of movement of the cathode member is controlled in accordance with the target amount of the film to be removed obtained from the thickness equivalent data.

6. A polishing method as set forth in claim 1, wherein the cathode member is moved stepwise from one region to another region of the surface.

7. A polishing method as set forth in claim 1, wherein, as the thickness equivalent data of the film, the thickness of the film is measured.

8. A polishing method as set forth in claim 1, wherein,

in the step of measuring the thickness equivalent data of the film, the thickness equivalent

data of the film in the region where the cathode member faces the surface is measured, and

the process of moving the cathode member to another region of the surface, measuring the thickness equivalent data of the film in that other region, and electrolytically polishing and flattening the film by electrolytic elution preferentially from projecting portions of the film in that other region until removing the target amount of the film obtained from the thickness equivalent data is repeated over the entire surface.

9. A polishing method as set forth in claim 8, wherein,

in the step of measuring the thickness equivalent data of the film, as the thickness equivalent data of the film, an electrolytic current of the electrolytic polishing is measured in the region where the cathode member faces the surface, and

in the step of electrolytically polishing and flattening the film by electrolytic elution in that region of the surface, the electrolytic polishing is performed until removing the target amount of the film determined by the electrolytic current of the electrolytic polishing.

10. A polishing method as set forth in claim 9, wherein, in the step of electrolytically polishing and

flattening the film by electrolytic elution in that region of the surface, the target amount of the film remaining at the point of time when the electrolytic current of the electrolytic polishing becomes a specified value is determined to be zero and the electrolytic polishing in that region of the surface is finished.

11. A polishing method as set forth in claim 1, wherein,

the cathode member is shaped so as to be able to apply a stronger electric field to a projecting portion than to a recessed portion of the film corresponding to the unevenness of the film in that region of the surface, and

in the step of electrolytically polishing and flattening the film by electrolytic elution in that region of the surface, by applying this electric field, the film is polished electrolytically and flattened by electrolytic elution in the region of the surface preferentially from a projecting portion of the film.

12. A polishing method as set forth in claim 11, wherein

the surface has a projecting and recessed pattern formed by repeating a projecting and recessed pattern in that region of the surface, and

by moving the cathode member stepwise to other

regions of the surface and applying the stronger electric field to the projecting portion than to the recessed portion of the film corresponding to the unevenness of the film in these other regions, the step of electrolytically polishing and flattening the film by electrolytic elution preferentially from projecting portions of the film is repeated over the entire surface.

13. A polishing method as set forth in claim 1, wherein

the cathode member is divided into a plurality of regions which are arranged insulated from each other and the cathode member as a whole faces the entire surface, and

by changing the position of application of voltage to the divided cathode member, the substantially equivalent is obtained as when changing the position of the cathode member facing the surface from one region to another region.

14. A polishing method as set forth in claim 13, wherein

the cathode member is divided into a plurality of concentric circular regions, and

the entire surface is electrolytically polished by changing the position of application of voltage from the inner side to the outer side of the cathode member

divided into concentric circular regions.

15. A polishing method as set forth in claim 1, wherein, when making a relatively small cathode member compared with the surface face that region of the surface, an anode member set apart from the cathode member at a certain distance is made to face the surface, an electrolytic solution is interposed at least between that region of the surface and the cathode member and between the surface and the anode member, and a voltage is applied to the cathode member and the anode member so as to apply the voltage de facto with the cathode member as a cathode and the surface as an anode.

16. A polishing method as set forth in claim 15, wherein the anode member is comprised of a nobler metal than the material on the surface.

17. A polishing method as set forth in claim 1, wherein, in the step of electrolytically polishing and flattening the film by electrolytic elution in that region of the surface, chemical mechanical polishing is performed at the same time as the electrolytic polishing to flatten the film by composite polishing combining the electrolytic polishing and the chemical mechanical polishing.

18. A polishing method as set forth in claim 1, wherein, when a voltage is applied with the cathode

member as a cathode and the surface as an anode, a direct-current voltage is applied.

19. A polishing method as set forth in claim 18, wherein a rectangular pulse voltage is applied.

20. A polishing method as set forth in claim 15, wherein, when a voltage is applied to the cathode member and the anode member, an alternating-current voltage is applied.

21. A polishing method as set forth in claim 1, wherein, in the step of electrolytically polishing and flattening the film by electrolytic elution in that region of the surface, an electrolytic current of the electrolytic polishing in the region is measured at the same time.

22. A polishing method as set forth in claim 21, wherein the voltage applied with the cathode member as a cathode and the surface as an anode is controlled to maintain the electrolytic current constant.

23. A polishing method as set forth in claim 21, wherein the progress in flattening the film in that region of the surface is managed through the electrolytic current.

24. A polishing method for polishing an object having a film on a surface to be polished, comprising the steps of

measuring data corresponding to a thickness of the film on the object;

making a relatively small cathode member compared with the surface face a region of the surface, interposing an electrolytic solution including a chelating agent at least between that region of the surface and the cathode member, and in that state applying a voltage with the cathode member serving as a cathode and the film as an anode to oxidize the surface of the film by anodic oxidation and form a chelate film of the oxidized material; and

selectively removing a projecting portion of the chelate film corresponding to unevenness of the film to expose the film of the projecting portion at the surface; wherein

a step of moving the cathode member from one region to an other region of the surface, the chelate film forming step, and the chelate film removing step are repeated until removing the target amount of the film determined from the thickness equivalent data over the entire surface to flatten the entire surface.

25. A polishing method as set forth in claim 24, wherein the film comprises a copper film.

26. A polishing method as set forth in claim 24, wherein the electrolytic solution further includes a

surface-active agent.

27. A polishing method as set forth in claim 24, further comprising a step of calculating the target amount of the film to be removed from the thickness equivalent data after the step of measuring the thickness equivalent data and before the chelate film forming step in that region of the surface.

28. A polishing method as set forth in claim 24, wherein the cathode member is moved continuously from one region to another region of the surface.

29. A polishing method as set forth in claim 28, wherein the speed of movement of the cathode member is controlled in accordance with the target amount of the film to be removed obtained from the thickness equivalent data.

30. A polishing method as set forth in claim 24, wherein the cathode member is moved stepwise from one region to another region of the surface.

31. A polishing method as set forth in claim 24, wherein, as the thickness equivalent data of the film, the thickness of the film is measured.

32. A polishing method as set forth in claim 24, wherein,

in the step of measuring the thickness equivalent data of the film, the thickness equivalent

data of the film in the region where the cathode member faces the surface is measured, and

the step of moving the cathode member to other regions of the surface, the step of measuring the thickness equivalent data of the film in these other regions, the chelate film forming step, and the chelate film removing step are repeated over the entire surface.

33. A polishing method as set forth in claim 32, wherein,

in the step of measuring the thickness equivalent data of the film, as the thickness equivalent data of the film, an electrolytic current of the anodic oxidation is measured in the region where the cathode member faces the surface, and

the step of measuring an electrolytic current of the anodic oxidation, the chelate film forming step, and the chelate film removing step are repeated over the entire surface until removing the target amount of the film determined by the electrolytic current of the anodic oxidation.

34. A polishing method as set forth in claim 33, wherein, when repeating the step of measuring the electrolytic current of the anodic oxidation in a region of the surface, the chelate film forming step, and the chelate film removing step over the entire surface, the

target amount of the film remaining at the point of time when the electrolytic current of the anodic oxidation becomes a specified value is determined to be zero and the chelate film forming step and the chelate film removing step in that region of the surface are finished.

35. A polishing method as set forth in claim 24, wherein

the cathode member is shaped so as to be able to apply a stronger electric field to a projecting portion than to a recessed portion of the film corresponding to the unevenness of the film in that region of the surface, and

in the chelate film forming step and the chelate film removing step in that region of the surface, by applying this electric field, the chelate film is formed and removed preferentially from projecting portions of the film to flatten the film.

36. A polishing method as set forth in claim 35, wherein

the surface has a projecting and recessed pattern formed by repeating a projecting and recessed pattern in that region of the surface, and

by moving the cathode member stepwise to other regions of the surface and applying the stronger electric field to the projecting portion than to the recessed

portion of the film corresponding to the unevenness of the film in these other regions, the step of chelating the film and removing the formed chelate film preferentially from a projecting portion of the film to flatten the film is repeated over the entire surface.

37. A polishing method as set forth in claim 24, wherein

the cathode member is divided into a plurality of regions which are arranged insulated from each other and the cathode member as a whole faces the entire surface, and

by changing the position of application of a voltage to the divided cathode member, the substantially equivalent is obtained as when changing the position of the cathode member facing the surface from one region to another region.

38. A polishing method as set forth in claim 37, wherein

the cathode member is divided into a plurality of concentric circular regions, and

the entire surface of the film is oxidized by anodic oxidation and chelated by changing the position of application of a voltage from the inner side to the outer side of the cathode member divided into concentric circular regions.

39. A polishing method as set forth in claim 24, wherein, when making a relatively small cathode member compared with the surface face that region of the surface, an anode member set apart from the cathode member at a certain distance is made to face the surface, an electrolytic solution is interposed at least between that region of the surface and the cathode member and between the surface and the anode member, and a voltage is applied to the cathode member and the anode member so as to apply the voltage de facto with the cathode member as a cathode and the surface as an anode.

40. A polishing method as set forth in claim 39, wherein the anode member is comprised of a nobler metal than the material on the surface.

41. A polishing method as set forth in claim 24, wherein, in the step of removing the chelate film in that region of the surface, a projecting portion of the chelate film corresponding to the unevenness of the film is selectively removed by wiping.

42. A polishing method as set forth in claim 24, wherein, in the step of removing the chelate film in that region of the surface, the chelate film is removed by applying vibration.

43. A polishing method as set forth in claim 24, wherein, in the step of removing the chelate film in that

region of the surface, the chelate film is removed by applying a jet.

44. A polishing method as set forth in claim 24, wherein, when a voltage is applied with the cathode member as a cathode and the surface as an anode, a direct-current voltage is applied.

45. A polishing method as set forth in claim 44, wherein a rectangular pulse voltage is applied.

46. A polishing method as set forth in claim 39, wherein, when a voltage is applied to the cathode member and the anode member, an alternating-current voltage is applied.

47. A polishing method as set forth in claim 24, wherein, in the step of oxidizing the film by the anodic oxidation in that region of the surface, an electrolytic current of the anodic oxidation in the region is measured at the same time.

48. A polishing method as set forth in claim 47, wherein the voltage applied with the cathode member as a cathode and the surface as an anode is controlled to maintain the electrolytic current constant.

49. A polishing method as set forth in claim 47, wherein the progress in flattening the film in that region of the surface is managed through the electrolytic current.

50. A polishing apparatus for polishing an object having a film on a surface to be polished, comprising

a table for holding the object,

a measuring means for measuring data corresponding to a thickness of the film on the object,

a cathode member relatively small compared with the surface and arranged to face a region of the surface,

an electrolytic solution feeding means for feeding an electrolytic solution at least between that region of the surface and the cathode member,

a power supply for applying a voltage with the cathode member serving as a cathode and the film serving as an anode,

a control means for controlling application of voltage until removing the target amount of film obtained from the thickness equivalent data when the film is electrolytically polished by electrolytic elution in that region of the surface, and

a moving means for moving the cathode member to other regions of the surface in order to remove the target amount of film over the entire surface.

51. A polishing apparatus as set forth in claim 50, wherein the film comprises a copper film.

52. A polishing apparatus as set forth in claim 50, further comprising a calculating unit for calculating the

target amount of the film to be removed from the thickness equivalent data.

53. A polishing apparatus as set forth in claim 50, wherein the measuring means measures a thickness of the film.

54. A polishing apparatus as set forth in claim 50, wherein

the measuring means measures an electrolytic current of electrolytic polishing in a region where the cathode member faces the surface, and

the control means controls a voltage to be applied until removing the target amount of film determined by the electrolytic current of the electrolytic polishing in that region of the surface.

55. A polishing apparatus as set forth in claim 54, wherein the control means determines the target amount of the film remaining at the point of time when the electrolytic current of the electrolytic polishing becomes a specified value to be zero and controls the electrolytic polishing in that region of the surface to finish.

56. A polishing apparatus as set forth in claim 50, wherein

the cathode member is shaped so as to be able to apply a stronger electric field to a projecting

portion than to a recessed portion of the film corresponding to the unevenness of the film in that region of the surface, and

by applying this electric field, the film is polished electrolytically and flattened by electrolytic elution in that region of the surface preferentially from a projecting portion of the film.

57. A polishing apparatus as set forth in claim 50, wherein

the cathode member is divided into a plurality of regions which are arranged insulated from each other and the cathode member as a whole faces the entire surface, and

by changing the position of application of voltage to the divided cathode member, the substantially equivalent is obtained as when changing the position of the cathode member facing the surface from one region to another region.

58. A polishing apparatus as set forth in claim 57, wherein the cathode member is divided into a plurality of concentric circular regions.

59. A polishing apparatus as set forth in claim 50, wherein

the apparatus further comprises an anode member facing the surface and set apart from the cathode member

at a certain distance,

the electrolytic feeding means feeds an electrolytic solution between the region of the surface and the cathode member and between the surface and the anode member, and

the power supply applies a voltage to the cathode member and the anode member.

60. A polishing apparatus as set forth in claim 59, wherein the anode member is comprised of a nobler metal than the material on the surface.

61. A polishing apparatus as set forth in claim 50, wherein

the apparatus further comprises a polishing means for chemical mechanical polishing and

performs the chemical mechanical polishing in that region of the film at the same time as the electrolytic polishing to flatten the film.

62. A polishing apparatus as set forth in claim 50, wherein the power supply applies a direct-current voltage with the cathode member as a cathode and the surface as an anode.

63. A polishing apparatus as set forth in claim 62, wherein the power supply applies a rectangular pulse voltage.

64. A polishing apparatus as set forth in claim 59,

wherein the power source applies an alternating-current voltage to the cathode member and the anode member.

65. A polishing apparatus as set forth in claim 50, further comprising an ammeter for measuring an electrolytic current of the electrolytic polishing in that region.

66. A polishing apparatus as set forth in claim 65, wherein the control means controls the voltage applied to the cathode member and the surface so as to maintain the electrolytic current constant.

67. A polishing apparatus for polishing an object having a film on a surface to be polished, comprising

a table for holding the object,

a measuring means for measuring data corresponding to a thickness of the film on the object,

a cathode member relatively small compared with the surface and arranged to face a region of the surface,

an electrolytic solution feeding means for feeding an electrolytic solution including a chelating agent at least between the region of the surface and the cathode member,

a power supply for applying a voltage with the cathode member serving as a cathode and the film as an anode,

a control means for controlling the application

of voltage until the surface of the film is oxidized by anodic oxidation in that region of the surface and a chelate film of the oxidized material is formed,

a chelate film removing means for removing the chelate film, and

a moving means for moving the cathode member to other regions of the surface in order to remove a target amount of the film obtained from the thickness equivalent data over the entire surface.

68. A polishing apparatus as set forth in claim 67, wherein the film comprises a copper film.

69. A polishing apparatus as set forth in claim 67, wherein the chelate film removing means selectively removes a projecting portion of the chelate film corresponding to unevenness of the film.

70. A polishing apparatus as set forth in claim 67, wherein, as an electrolytic solution, the electrolytic feeding means feeds an electrolytic solution further including a surface-active agent.

71. A polishing apparatus as set forth in claim 67, further comprising a calculating unit for calculating the target amount of the film to be removed from the thickness equivalent data.

72. A polishing apparatus as set forth in claim 67, wherein the measuring means measures a thickness of the

film.

73. A polishing apparatus as set forth in claim 67, wherein

the measuring means measures an electrolytic current of the anodic oxidation in a region where the cathode member faces the surface, and

the control means controls the voltage to be applied until removing the target amount of film determined by the electrolytic current of the anodic oxidation in that region of the surface.

74. A polishing apparatus as set forth in claim 73, wherein the control means determines the target amount of the film remaining at the point of time when the electrolytic current of the anodic oxidation becomes a specified value to be zero and controls the anodic oxidation in that region of the surface to finish.

75. A polishing apparatus as set forth in claim 67, wherein

the cathode member is shaped so as to be able to apply a stronger electric field to a projecting portion than to a recessed portion of the film corresponding to the unevenness of the film in that region of the surface, and

by applying this electric field, the film is oxidized by anodic oxidation and chelated in that region

of the surface preferentially from a projecting portion of the film to flatten the film.

76. A polishing apparatus as set forth in claim 67, wherein

the cathode member is divided into a plurality of regions which are arranged insulated from each other and the cathode member as a whole faces the entire surface, and

by changing the position of application of voltage to the divided cathode member, the substantially equivalent is obtained as when changing the position of the cathode member facing the surface from one region to another region.

77. A polishing apparatus as set forth in claim 76, wherein the cathode member is divided into a plurality of concentric circular regions.

78. A polishing apparatus as set forth in claim 67, wherein

the apparatus further comprises an anode member facing the surface and set apart from the cathode member at a certain distance,

the electrolytic feeding means feeds an electrolytic solution between the region of the surface and the cathode member and between the surface and the anode member, and

the power supply applies a voltage to the cathode member and the anode member.

79. A polishing apparatus as set forth in claim 78, wherein the anode member is comprised of a nobler metal than the material on the surface.

80. A polishing apparatus as set forth in claim 67, comprising a wiping means for selectively removing projecting portions of the chelate film corresponding to the unevenness of the film as the chelate film removing means.

81. A polishing apparatus as set forth in claim 67, wherein the chelate film removing means includes a vibration applying means.

82. A polishing apparatus as set forth in claim 67, wherein the chelate film removing means includes a jet generating and applying means for applying a jet to the chelate film.

83. A polishing apparatus as set forth in claim 67, wherein the power supply applies a direct-current voltage with the cathode member as a cathode and the surface as an anode.

84. A polishing apparatus as set forth in claim 83, wherein the power supply applies a rectangular pulse voltage.

85. A polishing apparatus as set forth in claim 78,

wherein the power source applies an alternating-current voltage to the cathode member and the anode member.

86. A polishing apparatus as set forth in claim 67, further comprising an ammeter for measuring an electrolytic current of the anodic oxidation in that region.

87. A polishing apparatus as set forth in claim 86, wherein the control means controls the voltage applied to the cathode member and the surface so as to maintain the electrolytic current constant.

88. A plating method depositing a plating film on a surface of an object, comprising the steps of

measuring surface height data of the surface or thickness data of the plating film on the object and

making a relatively small anode member compared with the surface face a region of the surface, applying a voltage with the anode member serving as an anode and the surface as a cathode while interposing an electrolytic plating solution at least between the region of the surface and the anode member, and depositing the plating film by plating in that region of the surface until depositing a target amount of the plating film deduced from the surface height data or the thickness data of the plating film at the time of the measurement; wherein

the process of moving the anode member to

another region of the surface and depositing a plating film by plating in that other region is repeated over the entire surface.

89. A plating method as set forth in claim 88, wherein the plating film comprises a copper film.

90. A plating apparatus for depositing a plating film on a surface of an object, comprising

a table for holding the object,

a measuring means for measuring surface height data of the surface or thickness data of the plating film on the object,

an anode member relatively small compared with the surface and arranged to face a region of the surface,

an electrolytic plating solution feeding means for feeding an electrolytic plating solution at least between that region of the surface and the anode member,

a power supply for applying a voltage with the anode member serving as an anode and the surface as a cathode,

a control means for controlling application of voltage until forming by plating a target amount of the plating film deduced from the surface height data or the plating thickness data at the time of the measurement in that region of the surface, and

a moving means for moving the anode member to

other regions of the surface.

91. A plating apparatus as set forth in claim 90, wherein the plating film comprises a copper film.